REMARKS

A substitute specification (including the abstract and title) has been prepared in order to improve the idiomatic English of the application and adapt it to US practice (as by avoiding claim-type language in the abstract). It is attached, along with a marked-up copy. The statement required under 37 CFR 1.125 appears on the first page of this Amendment.

The present Amendment revises claim 1 in response to the objection in Section 1 of the Office Action and the rejection for indefiniteness in Section 2, and to otherwise improve the form of the claim under US claim-drafting practice. The revisions to claim 1 also delete non-essential limitations (for example, that the tube be made of glass and that the gas be xenon). In addition to the foregoing revisions, claim 1 has been amended substantively. It now provides that the getter electrode is spaced apart from the high temperature electrode.

Section 5 of the Office Action rejects claim 1 (among other claims) for obviousness on the basis of the prior art acknowledged in the present application in view of US patent 4,303,846 to Kimura et al (hereafter simply "Kimura"). The Kimura reference discloses a discharge lamp having a sintered electrode 15 on one of its electrodes. Kimura's electrode 15 includes a high melting point metal and a getter (see column of the reference, lines 41-44).

The acknowledged prior art that is shown in Figure 1 of the present application's drawings includes an electrode 15. Perhaps an ordinarily skilled person who wanted to improve the acknowledged prior art might replace the electrode 15 shown in Figure 1 of the application with Kimura's sintered electrode 15. But this is not what is recited in claim 1. Claim 1 recites a "high temperature resistant electrode" and, separately, "a getter electrode." Moreover, claim 1 recites that the getter electrode is spaced apart from the high temperature electrode. Kimura teaches against what is recited in claim 1, by combining high temperature resistant material and getter material in a single element. Accordingly, Kimura would not provide an incentive for an ordinarily skilled person to modify what is shown in Figure 1 of the application's drawings by providing a getter electrode and, spaced apart from it, a high temperature resistant electrode.

Section 6 of the Office Action rejects claim 1 (among other claims) for obviousness on the basis of the admitted prior art in view of US patent 3,327,089 to Chow and US

patent 3,968,392 to Buchta et al (hereafter simply "Buchta"). The Chow reference discloses the use of getter on the anode or cathode of a discharge lamp. The discharge lamp disclosed in the Chou reference was invented by one of the coinventors of the present application (Shing Cheung Chow). In the 30 years since the reference issued, no one (until Chow teamed up with his coinventor in the present application) thought of improving the discharge lamp by adding a high temperature resistant electrode at a position spaced apart from the getter, despite the increasing popularity of flash photography. The Buchta reference discloses a discharge lamp with a small metal band 7 made of tantalum or some other elastic material having good thermoconductivity (column 2 of the Buchta, lines 64-67). The bands extend from the anode and cathode electrodes to the glass beneath the trigger electrode. However, it is likely that an ordinarily skilled person would regard one of Buchta's bands 7 as merely providing a capacitor plate on one side of the glass, opposite the trigger electrode, and a means for providing an electrical connection between this capacitor plate and the relevant anode or cathode electrode. Certainly there is nothing in the reference that would have led an ordinarily skilled person to modify a discharge lamp in accordance with the acknowledged prior art and the Chou reference by adding a high temperature resistant electrode at a position spaced apart from a getter electrode.

Since the remaining claims depend from claim 1 and recite additional limitations to further define the invention, they are patentable along with claim 1 and need not be further discussed. It is nevertheless noted that the Evans et al reference lacks a getter electrode, and that the Rutan et al reference differs considerably in construction from the acknowledged prior art, Chou, and Buchta. An ordinarily skilled person who wanted to improve some aspect of the acknowledged prior art would be unlikely to think that the Rutan et al reference might hold hints for such improvement.

It is noted that the application has been amended to include four additional dependent claims. Accordingly, a dependent claim fee of $36 (for a small entity) is being submitted concurrently. Should this remittance be accidentally missing, however, or should any additional fees be needed (including extension of time fees, since Applicants hereby provisionally petition for any extensions that may be deemed necessary to avoid abandonment), the Commissioner may charge such fees to our Deposit Account number 18-0002.

For the foregoing reasons, it is respectfully submitted that the application is now in condition for allowance. Reconsideration of the application is therefore respectfully requested.

Respectfully submitted,

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SUBSTITUTE SPECIFICATION - MARKED UP

FLASH DISCHARGE LAMP

The present invention relates to a flash discharge lamp having high power, high discharge frequency, and a long life expectancy.

BACKGROUND OF THE INVENTION

Figure 1 ~~is an~~shows the interior structure of an embodiment of ~~the~~ a flash discharge lamp commonly used in photographic ~~camera~~cameras. It comprises a glass tube 11; a pair of electrodes, i.e., an anode 12 and a cathode 13, oppositely disposed in at both ends of said glass bulb; a electro-conductive member 14 is provided on the outer surface of the glass tube; a electrode 15 and a triggering electrode 18 mounted on the cathode 13 and xenon gas sealed in said glass tube, ~~therein~~ wherein the triggering electrode 18 is electrically connected to said electro-conductive member 14. In operation, when an operating voltage is applied between the two electrodes 12 and 13, a trigger coil is activated to apply a high trigger voltage to the xenon gas, ~~whereby moleculae thereof are~~which is then electro-ionized. Under the action of the field formed between the two electrodes, ions and electrons are accelerated and come into collision with each other so that an electron avalanche effect is created. While all the xenon gas is nearly ionized and ~~the~~ a high temperature is produced, a high temperature plasma is formed in the glass tube and emits bright light, which ~~closes~~ comes close to sunlight, in a short period of time.

The flash discharge lamp undergoes high temperature with

each flash. Physical and chemical reactions occur over each component so that the electrodes in the tube become yellow gradually and the brightness decreases gradually.

In the photographic industries, the general life expectancy requirement of a stroboscopic discharge lamp is 3,000 flashes with a flash interval of 15 seconds, where skipping is not allowed. Light output of the flashes cannot be lower than 10% of its original specification before the life ends. In general, the flash discharge lamp can meet the customer criteria ~~with normal technical request~~. However, in recent years, the demand in the light output has been increased, which leads to an increase of the input power, the discharge temperature of the emitted ions, and the duration of the discharge temperature of the flash discharge lamp. Moreover, as its application has been growing into safety alarms and emergency lighting systems, there is a substantial increase in technical requirement of discharge frequency and longer life span. With the current strobe manufacturing technology, after 15,000 continuous flashes, a sputtering black ~~spot~~ residue appears on the inner surface of the strobe, the brightness output ~~to be decreased for~~ decreases by more than 30%, blackening appears at the electrode ~~end~~ ends and ~~becoming yellow at~~ the center of the strobe~~, all phenomenon appears after 15,000 continuous flashes~~ becomes yellow. With the increase of the discharge frequency, the ~~operation condition~~ operational conditions of the flash discharge will go from bad to worse due to the discharge temperature and contamination incurred ~~in~~ each ~~time of the~~ flash.

It is an object of this invention to overcome the drawbacks of the prior art, and to provide a flash discharge lamp having the characteristic of higher output power with a longer life span.

Another object of this invention is to provide a flash discharge lamp having a higher discharge frequency.

SUMMARY OF THE INVENTION

To accomplish the foregoing objects, the present invention provides a flash discharge lamp comprising a pair of electrodes i.e. an anode and a cathode, oppositely disposed in at both ends of the glass tube, a electro-conductive member is provided on the outer surface of the glass tube, a triggering electrode mounted on said cathode and electrically connected to said electro-conductive member, and xenon gas sealed in said glass tube, characterized in that said flash discharge lamp further includes at least one high temperature resistant electrode mounted on said cathode and at least one getter electrode mounted on said cathode and/or said anode.

By use of the flash discharge lamps according to this invention, the light output can be multiplied 3 to 10 times. In another words, it can increase the total luminous flux by 3 to 10 times, and the unilateral luminous intensity by 1 to 3 times. The life expectancy of the said lamp is extended by 0.5 to 4 times and up to 10 million times. Moreover, the application of the flash discharge lamp according to this invention has been extended to safety alarms and emergency lighting systems due to the increase in the discharge frequency.

BRIEF DESCRIPTION OF DRAWINGS

Preferred ~~embodiment~~ embodiments of the invention will now be described with the reference to the accompanying drawings, in which the reference numbers designate the corresponding parts therein. Other and further objects, features and advantages of the invention will become apparent from the following description:

Figure 1 is a sectional side elevation of a flash discharge lamp according to prior art.

Figure 2 is a sectional side elevation of first preferred embodiment of the flash discharge lamp according to this invention; and

Figure 3 is a sectional side elevation of second preferred embodiment of the flash discharge lamp according to this invention; and

Figure 4 is a sectional side elevation of third preferred embodiment of the flash discharge lamp according to this invention; and

Figure 5 is a sectional side elevation of forth preferred embodiment of the flash discharge lamp according to this invention; and

Figure 6 is a sectional side elevation of fifth preferred embodiment of the flash discharge lamp according to this invention.

DETAILED DESCRIPTION OF PREFERRED ~~EMBODIMENT~~EMBODIMENTS

In the flash discharge lamp according to this invention, at least two electrodes are used which have different functions. One electrode, taken as a High Temperature Resistant electrode, is made of high temperature resistant rare metal with a certain activity and its alloy thereby enabling the said lamp to withstand high temperature ion flushes. Another electrode, taken as a Getter electrode, is made of a more active rare metal and its alloy thereby possessing a desirable purifying effect.

The High Temperature Resistant electrode is made of tantalum and tantalum alloy, niobium and niobium alloy, or vanadium and vanadium alloy. In these materials, tantalum and tantalum alloy has extremely high melting point and therefore can withstand extremely high temperature. Although its oxidation activeness is not as active as titanium and zirconium, it is similar to other active metals in the sense that it produces non-reversible oxide. It is therefore able to absorb impure oxidative gases. However, tantalum and tantalum alloys have a lower diffusion coefficient of oxygen, so it is difficult for oxidative material absorbed on the surface to permeate inwards thereby reducing its surface oxygenic concentration and thus limiting its ability ~~of absorbing~~to absorb oxygenic materials. Niobium and niobium alloys have a melting point of over 2400°C and can withstand higher temperature. ~~It is~~They are also ~~a~~ more active and vigorous and ~~has~~ have a higher diffusion coefficient compared to that of tantalum. Niobium, an inexpensive material, and its alloys can produce non-reversible materials after reacting with oxidation gas and therefore have a higher ability to absorb oxygenic material compared to that of tantalum. Vanadium and its alloy have a melting point at 1920°C, which is lower than tantalum, niobium or their alloys; nevertheless, it is the most active among the three materials. Therefore, vanadium and vanadium alloy are the materials in between those used to make High Temperature Resistant electrode and Getter electrode, and they are suitable for a flash discharge lamp with a low power output yet ~~have~~ having certain purifying ~~characteristic~~characteristics.

Titanium and its alloy, or Zirconium and its alloy, are highly active materials ~~using~~ used for Getter ~~electrode~~electrodes. Under certain conditions, they can form a stable, non-reversible chemical compound after

reacting with all kinds of gases. Furthermore, they have a ~~higher~~ relatively high diffusion coefficient against external atoms, thereby swiftly diffusing ~~the~~ chemical ~~compound~~ compounds formed on the surface inwards, and rapidly cleaning the surface ~~then~~ and maintaining the purifying function over a long time. ~~With the high melting point at 1700 ° C, electrode is difficult to evaporate dirt and sputter inside the flash discharge lamp under high temperature.~~

According to the flash discharge lamp of this invention, the High Temperature Resistant electrode and the Getter electrode can be made of any combination of the above materials in order to achieve a better performance result.

Figure 2 is the first example of this invention, showing a structural diagram of a flash discharge lamp. A High Temperature Resistant electrode (25) made of tantalum alloy is affixed at the cathode (13) side (towards the anode side (12)) of the flash discharge lamp. A Getter electrode (26) made of titanium alloy is affixed at the cathode side (13) (towards the cathode side (13)) of the flash discharge lamp. The thickness of the tantalum alloy High Temperature Resistant electrode (25) and the titanium alloy Getter electrode (26) are 1.3mm and 1.1mm respectively. The operating voltage is 330V, triggering voltage is 4.5kV, xenon gas pressure is 200-300mmHg, and the main capacitor is 10μF. With 3 flashes per second, the life span of the flash discharge lamp can sustain up to 1 million flashes.

Figure 3 is the second example of this invention, showing a structural diagram of a flash discharge lamp. A High Temperature Resistant electrode (35) made of tantalum alloy is affixed at the cathode (13) side (towards the

anode side (12)) of the flash discharge lamp. A Getter electrode (36) made of zirconium alloy is affixed at the cathode side (13) (towards the cathode side (13)) of the flash discharge lamp. A second Getter electrode (37) made of titanium alloy is affixed at the anode side (12) of the flash discharge lamp. The thickness of the tantalum alloy High Temperature Resistant electrode (35), the zirconium alloy Getter electrode (36) and the titanium alloy getter electrode (37) are 1.3mm, 1.1mm and 1.1mm respectively. The operating voltage is 472V, triggering voltage is 4.0kV, xenon gas pressure is 350-450mmHg, the main capacitor is 47μF. With 8 flashes per second, the life span of the flash discharge lamp can sustain up to 10 million flashes.

Figure 4 is the third example of this invention, showing a structural diagram of a flash discharge lamp. A High Temperature Resistant electrode (45) made of niobium alloy is affixed at the cathode (13) side (towards the anode side (12)) of the flash discharge lamp. A Getter electrode (46) made of zirconium alloy is affixed at the cathode (13) side (towards the cathode side (13)) of the flash discharge lamp. A second Getter electrode (47) made of titanium alloy is affixed at the anode side (12) of the flash discharge lamp. The thickness of the niobium alloy High Temperature Resistant electrode (45), the zirconium alloy Getter electrode (46) and the titanium alloy Getter electrode (47) are 1.1mm, 1.0mm and 1.1mm respectively. The operating voltage is 285V, triggering voltage is 4.5kV, xenon gas pressure is 350-500mmHg, the main capacitor is 100μF. With one flash per second, the life span of the flash discharge lamp can sustain up to 1 million flashes, and the light output deteriorates less than 20%.

Figure 5 is the fourth example of this invention, showing a structural diagram of a flash discharge lamp. A High Temperature Resistant electrode (55) made of tantalum alloy is affixed at the cathode (13) side (towards the anode side (12)) of the flash discharge lamp. A Getter electrode (56) made out of titanium alloy is affixed at the cathode side (13) (towards the cathode side 13) of the flash discharge lamp. A second Getter electrode (57) made of vanadium alloy is affixed at the anode side 12 of the flash discharge lamp. The thickness of the tantalum alloy High Temperature Resistant electrode (55), the titanium alloy Getter electrode (56) and the vanadium alloy Getter electrode (57) are 1.3mm, 1.1mm and 1.1mm respectively. The operating voltage is 210V, triggering voltage is 6.0kV, xenon gas pressure is 400-500mmHg, the main capacitor is 10μF. With eight flashes per second, the life span of the flash discharge lamp can sustain up to 6 million flashes.

Figure 6 is the fifth example of this invention, showing a structural diagram of a flash discharge lamp. A High Temperature Resistant electrode (65) made of tantalum alloy is affixed at the cathode (13) side (towards the anode side (12)) of the flash discharge lamp. A Getter electrode (67) made of titanium alloy is affixed at the anode side (12) of the flash discharge lamp. The thickness of the tantalum alloy High Temperature Resistant electrode (65) and the titanium alloy getter electrode (67) are 1.3mm and 1.1mm respectively. The operating voltage is 220V, triggering voltage is 5.0kV, xenon gas pressure is 150-300mmHg, the main capacitor is 3μF. With eight flashes per second, the life span of the flash discharge lamp can sustain up to 10 million flashes.

The electrodes of the flash discharge lamp according to this invention are processed by the conventional practice

of powder metallurgy. The High Temperature Resistant electrode and the getter electrode are composed of different kinds of metals, the percentages of such metal weightings distributed from the above examples are as follows:

1. Tantalum alloy: tantalum-niobium (or vanadium) 2-25% - titanium (or zirconium) 0.1-10%
2. Niobium alloy: niobium-tantalum (or vanadium) 2-25% - titanium (or zirconium) 0.1-10%
3. Vanadium alloy: vanadium-niobium (or tantalum) 2-25% - titanium (or zirconium) 0.1-10%
4. Titanium alloy: titanium-aluminum 0.5-4% - cerium, barium, calcium, cesium (small quantities)
5. Zirconium alloy: Zirconium-titanium 0.5-10% - aluminum 0.1-1% - cerium, barium, calcium, cesium (small quantities)

The operation of the flash discharge lamp according to this invention is analogous to that of the existing flash discharge lamp, but since at least two electrode attachments with High Temperature Resistance and purifying functions are being constructed on the cathode and anode, the forte of each electrode attachment can be brought into full play. As a result, the lamp's output power has been raised, the heat and contamination, which are caused by flashes, have been reduced more quickly and effectively, the discharge frequency has been increased and the lamp's life span has also been extended. Beyond question, these are only a few specific illustrations of achieving the best result of this invention by using electrode attachment of different materials and different arrangements. For example, the said Getter electrode can be made of the more common Nickel alloy; the said Tantalum alloy can be Tantalum-Titanium or Tantalum-Zirconium alloy; the said Niobium alloy can be Niobium-Titanium or Niobium-Zirconium alloy; the said Vanadium

alloy can be Vanadium-Titanium alloy and so forth. Changes and variation in arrangements like these are also part of this invention.

ABSTRACT OF DISCLOSURE

A flash discharge lamp ~~comprising:~~includes a pair of electrodes i.e. an anode and a cathode, oppositely disposed in at both ends of the glass bulb~~, a~~. An electro-conductive member is provided on the outer surface of the glass tube~~, a~~. A triggering electrode is mounted on ~~said~~ the cathode and electrically connected to ~~said~~ the electro-conductive member~~, and xenon~~. Xenon gas is sealed in ~~said~~ the glass tube~~, said~~. The flash discharge lamp further includes at least one High Temperature Resistant electrode mounted on ~~said~~ the cathode and at least one Getter electrode mounted on ~~said~~ the cathode and/or ~~said~~ the anode. Not only can the above design increase the discharge output power and the discharge frequency, but it also ~~extend~~ extends the life expectancy of the flash discharge lamp. ~~The flash discharge lamp according to this invention goes further in the scope of application.~~